Natural Terrace Build-up Under Contour Strip-Cropping with Trees on Highly Erodible Land in Southern Iowa

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Jerry Bratton
USDA Forest Service
Center for Semiarid Agroforestry
East Campus, UNL
UNL, P.O. Box 830822
Lincoln, Nebraska 68583-0822

Dear Jerry:

Enclosed is a copy of the final report for Cooperative Agreement No. 28-C4-787 for the period October 1, 1996 to September 30, 1997.

This project demonstrated protection of highly erodible soils from erosion as the natural terraces form in the strip-cropping with trees land use pattern. This concept provided excellent erosion control of the intensive row crop area above the tree strips in this demonstration. The rill and sheet erosion has been controlled below tolerance limits. Geode RC&D and Des Moines Soil and Water Conservation District believe that this type of practice has high merits for promotion throughout the State of Iowa.

Sincerely,

David W. Countryman

David W. Countryman
Professor

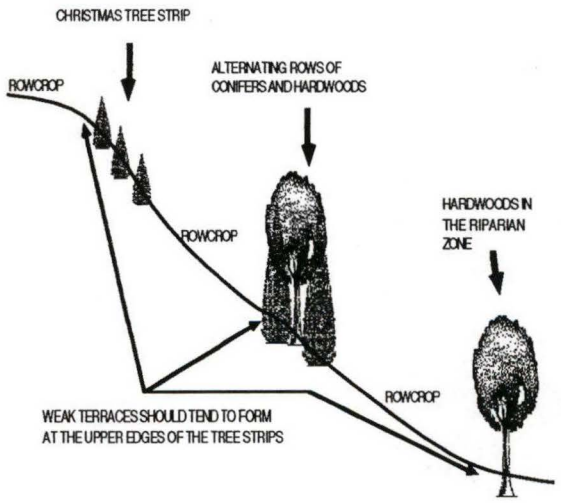
cc: J. Michael Kelly, Chairman
Department of Forestry

Ronald Snyder
Geode RC&D Coordinator

NATURAL TERRACE BUILD-UP UNDER CONTOUR STRIP-CROPPING WITH TREES ON HIGHLY ERODIBLE LAND IN SOUTHEAST IOWA

Cooperative Agreement No. 28-C4-787

FINAL REPORT



Prepared by David W. Countryman, Department of Forestry, Iowa State University, Ames, Iowa and submitted to USDA Forest Service, Rocky Mountain Research Station, Center for Semiarid Agroforestry, Lincoln, Nebraska for the period June 1, 1994 to December 30, 1997.

The Concept

To apply contour strip-cropping with trees to an area, strips of agricultural crops are alternated with strips of trees across the face of slopes. The agricultural crop strips are established and maintained as contour strips that could be easily farmed with standard farm equipment. The width of these parallel strips are: (1) constant for the entire strip length, and (2) determined by machinery width and maximum slope distance of rowcrop allowable to control soil erosion. Between the strips of agricultural crop are strips of grass-cover with contour rows of trees. The tree strips vary in width along the length of the strip to accommodate the natural lay of the land.

Planting high-value hardwoods in the tree strips provide long-term economic gains from the sale of sawlogs and veneer while agricultural crops provide an annual income. Several species of high value hardwoods, including black walnut (*Juglans nigra L.*), oaks (*Quercus* spp.), and ashes (*Fraxinus* spp.), should be considered depending on site characteristics. Planting more than one species in the strips increases species diversity and reduces risks from insects and diseases. The rowcrop strips are wide enough that they do overgrow with trees and, thus, would remain productive for the entire length of the tree rotation. The rowcrops are managed in a conventional crop rotation.

Incorporating trees into current farming methods decreases the overall risk in the farming operation by integrating a variety of crops that respond to diverse markets. The rowcrops provide cash flow while the tree strips act much more like an Individual Retirement Account, a savings account, or a long-term investment. Planting alternating rows of conifers are planted in the high value hardwood tree strips to provide trainer trees to improve the quality of the high value hardwoods. To produce greater bole quality on the high value hardwoods, the outside rows of the tree strips should always be conifers. The narrowest strip of trees that provides this training for high quality hardwoods is a three row strip: conifer-hardwood-conifer. At a 10-foot spacing between rows, this narrowest tree strip is 30 feet wide. Strips with an even number of rows would have two hardwood rows side by side somewhere in the strip (e.g., four-row strip: conifer-hardwood-hardwood-conifer; six-row strip: conifer-hardwood-hardwood-conifer-hardwood-conifer).

Mixing conifers in the tree strips also provides winter thermal cover for wildlife, whereas the strips themselves provide wildlife travel corridors. The mixture of multiple tree species and varied rowcrops provides increased ecological and aesthetic diversity. This increased edge should result in increased numbers of wildlife species as well as increased population levels.

Maintaining grass between the rows of trees in the tree strips provides a filter strip across the slope to stop movement of soil originating in the rowcrop strips. Over time this forms a natural, low terrace at the upper edge of the tree strip. With the proper type of ground-cover control in the tree rows, there should be complete stability of the soil within the tree

filter strip. Compared to bare ground, the resistance to water movement is 10-fold greater for light turf, 17.5 times greater for heavy turf, and 20-fold greater for a well-established tree litter layer (Satterlund, 1972). The strips should also act as a recharge zone for soil moisture because of the infiltration capacity that develops on undisturbed soils with tree cover.

Christmas tree production could be included in the strips of trees (Figure 1). Christmas trees would produce less shading of the rowcrop strips. Also, Christmas tree production is a profitable alternative to rowcrop production (Countryman and Kelley, 1981).

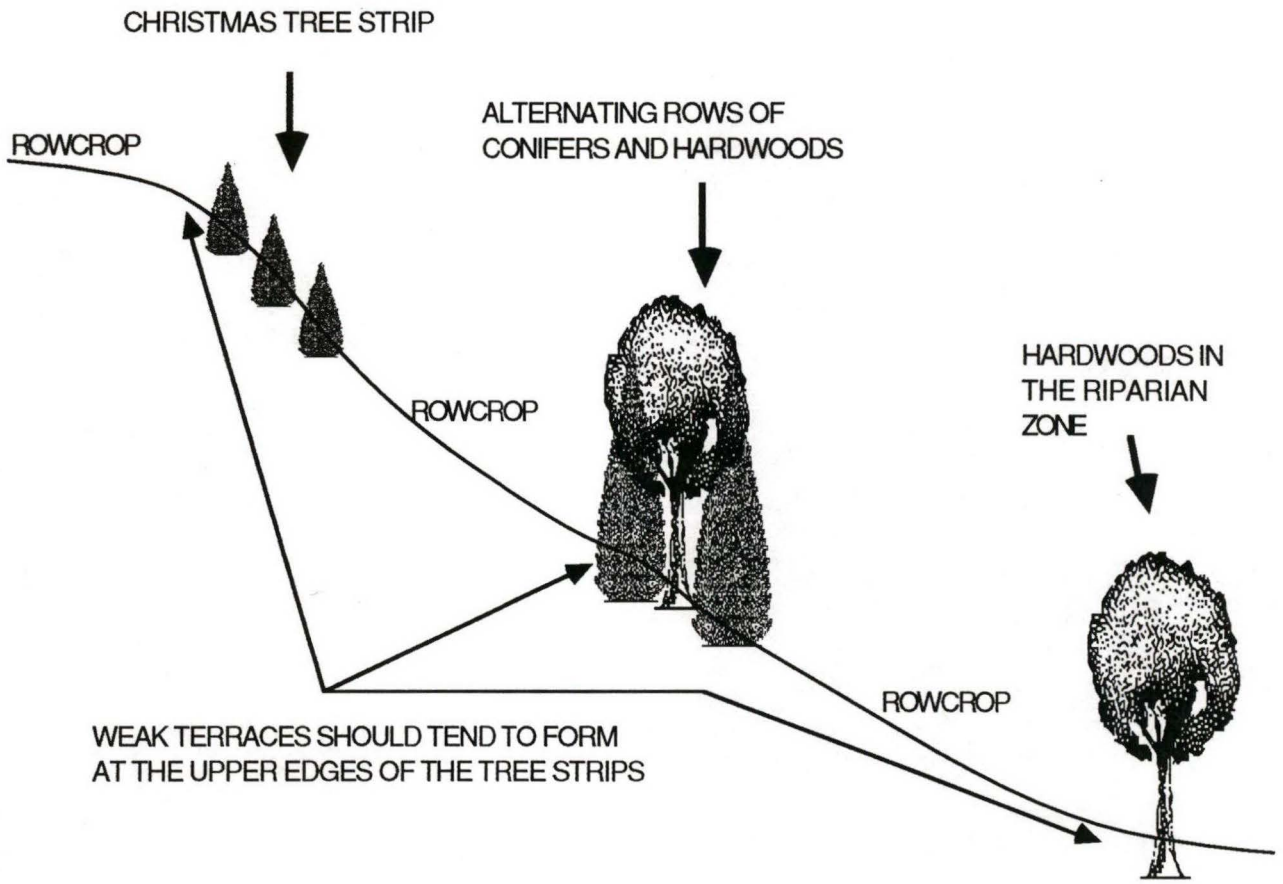


Figure 1--Illustration of the cross section of a hill showing rowcrop strips alternated with tree strips of Christmas trees, high value hardwoods, and terminating at the base of the hill in riparian vegetation.

The Iowa Army Ammunition Site

This project began June 1, 1994. The area of contour strip cropping with trees was established on Tract #1 in the extreme northwest area of the Iowa Army Ammunition Plant by Highway 79, south of Highway 34. The area is approximately 40 acres of Hedrick and Gara-Rinda soil types which are moderately well to somewhat poorly drained. These soils are poorly suited for row crop without conservation tillage and contour terraces. Most areas should be used for hay and pasture, however, these soils are moderately suited to native hardwood trees.

Tree strips were established at the locations where terraces would have been constructed on the hill. A mix of red pine, white pine, and scotch pine were planted in the outside and alternating rows of the tree strips. Hardwood trees were planted in the remaining alternate rows. All trees were planted 3 to 4 foot spacing in the row and 9 feet between the rows. First year survival rate was about 72%. Each year the tree rows in the tree strips have been sprayed with Roundup, Princep 4L, Pendulum or Oust. Vegetation between the rows was mowed. In 1996 and 1997 seedlings were replanted to fill gaps in the tree rows. To date, the tree survival is 73%.

Minimum tillage was used to plant rowcrops above and below the tree strips: corn in 1995, soybeans in 1996 (Figure 2), and corn in 1997 (Figure 3). The rowcrop area was parallel and could be easily farmed with large equipment because point rows are in the tree strips. The average soybean yield was approximately 36 bushels per acre and corn yield was 85 bushels per acre.

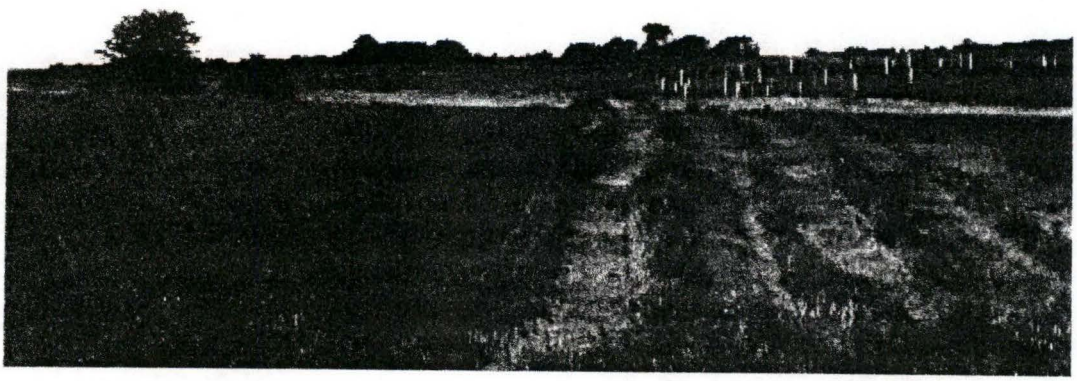


Figure 2--Soybeans planted above and below the tree strips in 1996. (Photo by Geode RC&D)

Figure 3--Corn planted above and below the tree strips in 1997. (Photo by Geode RC&D)

Twenty-two randomly located transects were established to measure sediment deposition. Rulers were fastened to wooden stakes (Figure 4) to measure deposition, and data were collected each October. Soil deposition within this project shows, that on the average, deposition occurred mostly in the first tree row and was reduced across the tree strip. By the third tree row, deposition had been reduced by over 75% (Figures 5 and 6). And, there was no deposition in the fifth tree row indicating that tree strips with five or more rows of trees kept all soil that eroded from the agricultural strip from moving beyond the fifth row of trees and leaving the site.

There was a problem with frost heaving of the stakes over winter and deer disturbing the stakes. As a result, further study is needed to confirm the sedimentation amounts, but the trend was significant and there was evidence that tree strips that are five rows (i.e., 45 feet) wide stop all erosion from agricultural activities above the strips (Figures 5 and 6). The disappearance of sedimentation in row 4 in 1997 may be a result of frost heaving or deer disturbance (Figure 6).

This project demonstrated protection of highly erodible soils from erosion as the natural terraces form in the strip-cropping with trees land use pattern. This concept provided excellent erosion control of the intensive row crop area above the tree strips in this demonstration. The rill and sheet erosion has been controlled below tolerance limits. Geode RC&D and Des Moines Soil and Water Conservation District believe that this type of practice has high merits for promotion throughout the State of Iowa.

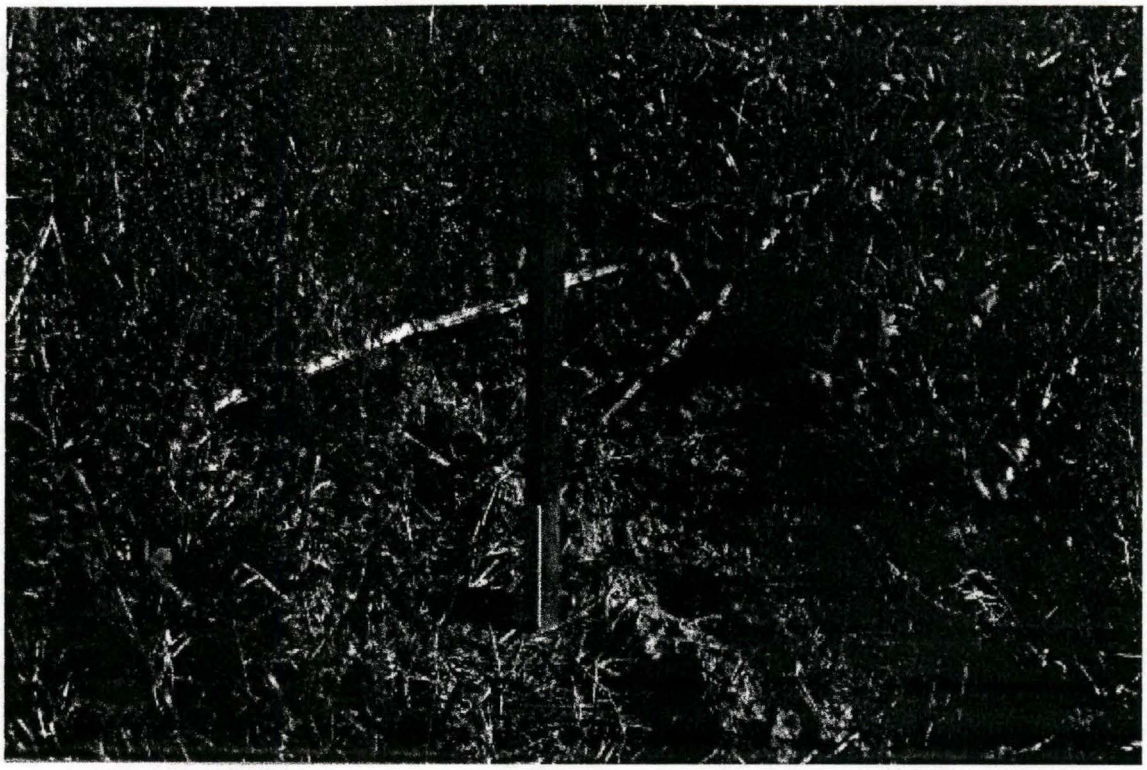


Figure 4--Rulers mounted on wooden stakes were used to measure sedimentation. (Photo by Geode RC&D)

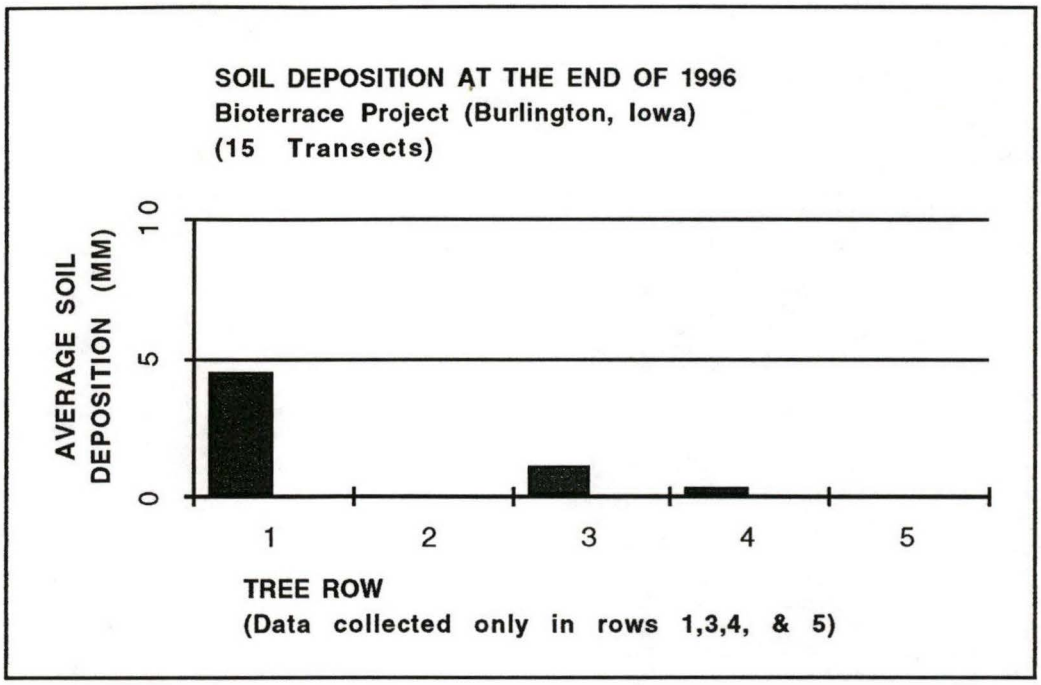


Figure 5--Soil deposition at the end of 1996 in the bioterrace project at Burlington, Iowa.

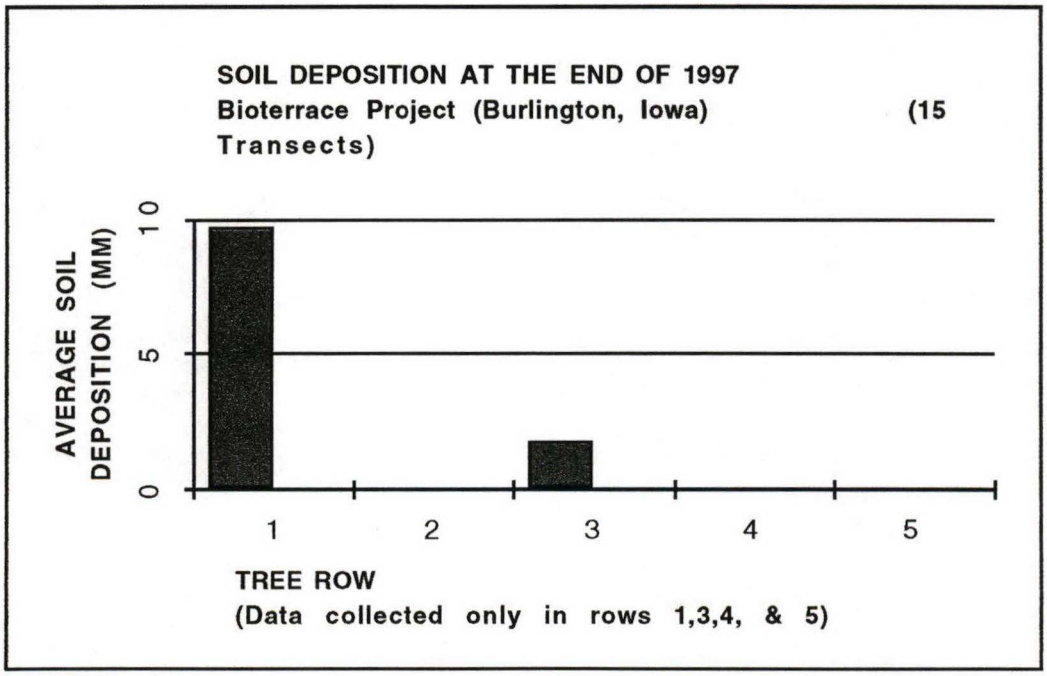


Figure 5--Soil deposition at the end of 1997 in the bioterrace project at Burlington, Iowa.

On June 11-13, 1997, an agroforestry meeting was held in West Lafayette, Indiana where a poster was presented on this project. Approximately 90 people were in attendance including representatives from the Department of Natural Resources, Natural Resources Conservation Service, Extension Service, Trees Forever, forestry personnel from universities in eight states, professional forestry consultants, and private individuals.

Other groups that have toured and reviewed this bioterrace project include the Soil and Water Conservation District Commissioners, the Agriculture Department at Southeastern Community College, Extension Office, Department of Natural Resources Forestry Division from both Iowa and Wisconsin, and local farmers.

Literature Cited

Countryman, D. W. and D. P. Kelley. 1981. Management of existing hardwood stands can be profitable for woodland owners. Iowa State Journal of Research, 56(2):119-130.

Satterlund, D. R. 1972. Wildland Watershed Management. Ronald Press Co. New York. 370 p.